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## MODERN METHODS OF GRASSLAND CONSERVATION AND UTILIZATION

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### Introduction

"Grass is the forgiveness of nature - her constant benediction. The primary form of food is grass. - Grass feeds the ox; the ox nourishes man; man dies and goes to grass again; and so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward, and in more sense than one, all flesh is grass." This wonderful tribute to grass is taken from an article written in 1872 by the Honorable John J. Engles, United States Senator from Kansas. This totally describes the important role that grass plays in our existence. Grass, and I shall use this term to include legumes also, is the universal crop, the cover for the soil, the sustainer of our livestock economy. The importance of grass is nowhere better illustrated than on this beautiful island where such a lush verdure is evident on every hand and where numerous good herds of cattle enjoy its abundance, and where large amounts of milk are enjoyed by the people. Ireland holds a foremost position among all nations in the per-capita production and the per-capita consumption of milk.

Grass and cattle are almost synonymous terms to the livestock farmer. In my country about 73 percent of the feed consumed by dairy cattle, 85 percent of that by beef cattle, and 93 percent of that by sheep come from grass (grasses and legumes) in the form of pasture, hay, fodder and silage. I would guess that in Ireland the percentage is even higher.

Grassland crops, in addition to being essential for good land use practices, if managed properly, produce large amounts of feed of high nutritional value and at low costs compared to other farm produced feed

<sup>1/</sup> Talk given at meeting of Irish Grassland Association, Dublin, Ireland, July 31, 1959.

crops or purchased feeds. On the other hand, grassland crops that are not properly managed and developed can be low yielding, poor in nutritional value and expensive feeds. One of the great challenges before the livestock farmer then is the proper development, management and utilization of the grassland crops that he grows on his farm.

Efficient use of grasslands involves production, management, conservation and utilization by livestock. I believe we know much more about production since through the years this has been given great attention by agronomists, soil specialists and plant breeders. I do not propose to deal with production problems at this meeting. Suffice to say that it is essential that every effort be made to obtain high sustained yields throughout the growing season and for as many seasons as possible.

My discussion will deal with the management, conservation and utilization from the standpoint of high level of animal production. In my remarks, I shall refer liberally to data obtained in the United States, with which I am familiar. I trust that much of what I present will also apply to Irish conditions.

#### Forage Crops Are Cheap Sources of Feed Nutrients

Productive forage crops are found to be cheap sources of feed nutrients. This fact is supported by data in table 1 developed at the Beltsville Agricultural Research Center. However, to make full use of this fact the forage must be of good quality and utilized with a minimum of loss and wastage in all phases of its management.

Table 1.- Cost of 100 lbs. of total digestible nutrients 1/

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Orchard grass-ladino pasture in rotation with crops.....	\$0.69
Bluegrass-white clover pasture well managed.....	0.71
Mixed hay.....	1.10
Corn silage.....	1.35
Wheat.....	2.56

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1/ From ARS 52-2, 1954, USDA.

### The Importance of Legumes

One of the first considerations in producing high yielding and highly nutritious forage is to include a large amount of legume in the crop. Alfalfa, of course, is the so-called king of perennial forages. Alfalfa, or a mixture of alfalfa and grasses, is the major forage used in the United States. The clovers, especially white and ladino clovers, are also very useful in mixtures.

The influence of legumes in grassland forage is apparent in the soil, in the herbage, in the cow, and in her milk. The beneficial effects of growing legumes alone or in association with grasses may be summarized as follows: (1) There is an increase in crop yield; (2) nitrogen fertility of the soil is maintained or increased; (3) there is an improvement in the texture of the soil; (4) there is an increase in the protein content of the grass and of the total crop; (5) there is an increase in the calcium content of the crop; (6) there is an increase in the palatability of the herbage; (7) there is a stimulating effect on the yield of succeeding crops; (8) there are fewer weeds in the field; (9) there is a somewhat better distribution of forage growth throughout the season; and (10) by virtue of a high carotene content of legumes the vitamin A value of milk often is increased.

The influence of legumes in forage on the yield of dry matter and protein is illustrated in table 2.

Table 2.- The influence of ladino clover on yield and protein content of mixed herbage 1/

Crop or crop combination 2/	: Dry matter :		Protein yield
	: yield	: content	
	: per acre	: percent	: per acre
	: Pounds	: Percent	: Pounds
Orchard grass alone-----:	2,392	: 12.3	: 231
Ladino clover alone-----:	3,852	: 27.0	: 1,026
Orchard grass and ladino clover (when grown together)-----:	7,981	: 16.5	: 1,174
Orchard grass (when grown with ladino clover)-----:	6,575	: 14.3	: 815
Ladino clover (when grown with orchard grass)-----:	1,406	: 27.0	: 359

1/ Unpublished data obtained from the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.

2/ Weed free.

Also, the influence of the percentage of legume on the TDN (Total Digestible Nutrients) yield of renovated bluegrass pasture is shown in table 3. Here again the presence of a high percentage of legumes increased yields of TDN to high levels. These are clear indications of the importance of legumes in pasturage. The problem is one of introducing and keeping legumes in the sod in desirable amounts. Renovation of permanent pastures is one way of doing this. The problem is somewhat less with crop rotation pastures since they are down for a shorter period of time and are turned before the legumes run out.

Table 3.- Association between TDN yield of pasture and the percentage of legumes 1/

Year following renovation	Basic bluegrass sod			
	Renovated 2/		Unrenovated	
	Legumes	TDN yield	Legumes	TDN yield
Second-----:	37	: 4,414	: 22	: 2,911
Third-----:	32	: 4,001	: 18	: 2,951
Fourth-----:	18	: 3,995	: 10	: 2,403
Fifth-----:	12	: 3,190	: 6	: 2,253
Average-----:	25	: 3,899	: 12	: 2,629
Average yearly in- crease by renovated: pastures (%)-----:	---	: 48	: --	: --

1/ Data taken in part from U. S. Dept. Agr., Bur. Dairy Indus. BDI-Inf-97, issued in 1950.

2/ Renovation treatment consisted of tearing up the old sod by disking in the fall and spring, and spring seeding 8 pounds of alfalfa, 3 pounds of red clover, and 1 pound of ladino clover per acre. Renovated and check pastures each received 10 tons of manure, 1 ton of limestone, and 500 pounds of 0-14-14 fertilizer at the time of renovation.

Some of these comparative advantages of legumes over grasses are being overcome through heavier use of nitrogen fertilizer on grasses. Heavy applications of inorganic nitrogen to mixed herbage generally reduce the content of legume and promote the growth of grass. Increased yields of forage from grasses thus can be achieved by this means, the grass also being higher in protein and carotene and in palatability and general feeding value than when little or no nitrogen is used. This is especially true when there is ample moisture available in the surface soil.

### Pastures and Pasture Management

Pasture is the most important grassland crop. It can be made to take care of the herd for periods of 6 to 8 months of the year. It was pointed out that highly productive pasture is the cheapest source of feed. On the other hand, poor rundown pasture can be a most expensive feed.

The objective of an effective pasture program should be to provide the herd with a continuous, abundant supply of palatable, nutritious pasturage each day over the longest possible grazing season. Given a productive pasture, the management practices must be so conducted that the available forage is grazed at the proper stage (4 to 8 inches high) that produces the greatest nutritive effect. The grazing herd should be so handled that the pasturage is utilized for productive purposes with a minimum of wastage. How well this is done may determine the difference between profit and loss from the pasture crop.

### Systems of Pasture Management

We have given a lot of attention to pasture management. We have learned that the use of a rotational grazing system, with the animals confined to small paddocks at 4 to 8 day intervals, in a 4 to 8 paddock scheme, gives increased yields amounting to 8 to 10 percent over the open pasture system. The use of the daily rotational scheme where the animals are confined to much smaller areas but are rotated to new areas each day is successful on many farms, but in some situations its advantages have not been fully demonstrated over the conventional rotation system. Some studies show a 10 to 15 percent advantage for daily rotational grazing, others do not. The development and use of electric fences and easy to move posts have been useful in this type of grazing management.

With any of the three systems of grazing it is important to avoid allowing the available forage to get ahead of the grazing herd.

If this occurs, the surplus should be harvested and removed, the grazed sward cut and, of course, the animal droppings should be periodically spread by dragging the pasture area.

The practice of green feeding or soiling, where the forage produced on land usually pastured is harvested and brought to the animals kept in dry lot, is receiving a great deal of attention in my country. The development and wide-scale use of direct cut field harvesting equipment have made it possible to harvest and feed the fresh green forage mechanically and expeditiously. Many farmers now are using the system and others are turning to it all the time. Research studies report conflicting results, some showing increased animal performance and acre yields when soiling is used, while others do not. The advantages seem to be more apparent when tall growing crops, such as alfalfa, broom grass, sudan grass, etc., are used than when the low growing crops such as bluegrass, orchard grass and ladino clover are used. With the present trend toward mechanization of farming operations, this system of feeding cows in the summer will probably receive more attention in future years. I believe it has the big advantage that as a farmer feeds his animals in the manger he will be more inclined to see that they get enough to eat. It also promotes the cleaning of the forage completely from the land at regular intervals, thus avoiding accumulation of mature, unpalatable forage and, of course, the avoidance of clumping effects, due to animal excrement.

#### Supplemental Pastures and Irrigation

In many areas of my country the hot, dry weather in the summer causes the perennial, permanent pasture crops to become quite unproductive. This is being met in two ways: One, to provide additional supplemental grazing with meadow aftermath or with annual pasture crops such as Sudan grass; the other is by irrigation of part or all of the permanent pasture. Both are effective in providing the needed forage to keep animal performance from falling off to uneconomic levels. An illustration of how effective supplemental irrigation is to permanent pasture is the data in table 4.

Table 4.- Influence of supplemental irrigation on the yield of pasture at the Lewisburg, Tenn., dairy station (3-year average)

Pasture treatment	Milk yield per acre 1/	Income over cost of feed and irrigation
	Pounds	Dollars
Irrigated pasture-----	12,520	388.78
Non-irrigated pasture-----	8,019	289.10
Increase from irrigation-----	4,501	99.68
Percentage increase from irrigation-----	56	35

1/ 4-Percent fat-corrected milk.

#### Good Quality Harvested Forage Essential in Winter Feeding

The forage supply is just as important for the winter season as it is for the summer. Harvested forage should not be looked on solely as the maintenance part of the ration, but as an important source of nutrients for both maintenance and production. Therefore, it should be available and in abundant supply, and of equal importance, it should be of good quality so that it will be consumed in large amounts to contribute as much nutrients as possible.

I am talking now primarily of the conservation of grassland forages put up as hay or grass silage. The objective is to put the forage in a form that it will keep until needed with as little loss as possible in poundage and quality of nutrients.

#### Influence of Stage of Maturity on Yield, Quality, and Feeding Value of Forage

The stage of maturity at which harvested forage is utilized has great influence on the yield and its digestibility and feeding value. This is illustrated by the data in table 5. As stage of maturity increased, the fiber content of the orchard grass increased and the protein content, protein and fiber digestibility, and the TDN content decreased. A hundred pounds of the mature hay contained only 86 percent as much TDN as 100 pounds of a grain mix, while the early cut hay contained 97 percent as much.

Table 5.- Relation of stage of maturity, composition, digestibility, and nutrient content of orchard grass hay (dry matter basis) 1/

		Protein		Fiber		Nutrient Content		Pounds grain
		Per- cent	Digest- ability	Per- cent	Digest- ability	TDN		mix to equal 100 pounds
		coeffi- cient	coeffi- cient	coeffi- cent	coeffi- cient	protein		hay 2/
1. Pasture-cut								
	May 19	24.8	67	26.9	81	16.6	70.3	93.7
2. Early hay- cut May 31		15.8	63	28.2	77	11.0	72.9	97.2
3. Medium hay- cut June 14		13.0	59	31.8	71	7.7	67.4	90.0
4. Mature hay- cut June 27		12.4	59	35.0	68	7.3	64.5	86.0

1/ Adapted from Ely et al. Jour. Dairy Sci. 46, 4, 325, 1953.

2/ Grain mix considered to contain 75 percent TDN

Harvesting forage in the early stages of maturity also produced greater yields of digestible protein and nutrients per acre. This is illustrated in tables 6 and 7 reporting results of a 3-year study on the yield and feeding value of alfalfa hay harvested at 3 stages of maturity. When these hays were fed to milking cows as the only feed, the production of milk per cow per day was greater and the hay required to support a cow and produce 100 pounds of 4 percent milk was less for the initial bloom hay than for that cut at later stages. The calculated milk yield per acre of the initial-bloom hay was 20 percent greater than for the half-bloom hay and 63 percent greater than for the full-bloom hay. Much of this big difference was found to be due to the lower total seasonal yield of the hay cut in the later stages of maturity.

These and other available data clearly indicate that one good way for farmers to insure higher quality, nutritious feed with larger yields of digestible nutrients per acre is to harvest their forage crops in the early stage of maturity.

Table 6.- Protein content and yields of dry matter, protein and total digestible nutrients per acre of alfalfa harvested at initial, half, and full bloom stages (3 year average) 1/

Stage of maturity	Protein content	Dry matter digestibility 2/	Dry matter yield	Protein yield	TDN yield (calculated)	TDN content 2/
	Percent	Percent	Pounds	Pounds	Pounds	Percent
Initial bloom	18.2	77.7	7,896	1,427	4,660	59.0
Half bloom....	18.3	77.1	7,778	1,381	4,413	56.7
Full bloom....	15.7	75.4	6,061	977	3,269	53.9

1/ From USDA Tech. Bul. 739, 1940.

2/ Determined with sheep on the 1937 crop of hay and used for the average for the 3 years.

Table 7.- Comparative calculated milk production per acre of alfalfa harvested at three stages of maturity and fed to dairy cows 1/

Stage of maturity of hay	Average daily produced		Hay required for support of cow and 100 pounds FCM required	Estimated yield of milk per acre
	Pounds	Pounds	Pounds	Pounds
Initial bloom	27.9	19.6	141.6	6,194
Half bloom....	23.6	19.2	167.8	5,145
Full bloom....	20.8	17.9	176.6	3,814

1/ Adapted from USDA Tech. Bul. 739, 1940.

#### Relation of Methods of Harvesting and Storage to Losses and Changes in Feeding Value

Forages intended for barn feeding, even though they are properly grown so that they are high yielding and nutritious and are cut at the proper stage of maturity, still must face the hurdles of harvesting and storage before they get to the cows. The harvesting methods used and the weather conditions prevailing during harvesting have much to do with the appearance, character, quality, and nutritive value of the preserved forage. With the

changes that take place in these characteristics of forage during harvesting and storage go variable losses in dry matter and feed nutrients, which are not so apparent to the average person. The best way to harvest and storage forage presents a critical problem to every dairyman, especially those in the humid and semi-humid regions.

Only recently, I believe, have we become fully aware of the high losses in feed that occur from harvesting and storing forage. Recent Beltsville research on this problem is summarized in table 8. The losses resulting from harvesting forage from the same fields by four different methods were carefully measured over a 6-year period. The high losses of feed nutrients observed are rather typical, I believe, of what is happening when harvesting forages in the humid regions. The losses from field curing were staggering. Artificial dehydration (using a portable rotary drum drier) appeared slightly the most efficient, but at present this method is not very practical. The silage method appeared the most practical and next most efficient. Barn drying, using heat, closely approximated the silage method, but it usually is difficult to provide a source of heat with most farm installations. The silage method reduces losses by one-third to one-half compared with field curing.

Table 8.- Losses of dry matter and feed nutrients from alfalfa mixed forages harvested and stored in different ways 1/

	Field-cured hay	Barn-finished hay		Artificial Silage	dehy- drat-
	Rained on : No on : rain	No : heat			
Dry matter, percent :	36.6	21.0	19.0	15.2	16.8
Protein, percent... :	46.1	27.7	24.0	21.3	16.9
Carotene, percent... :	99.1	96.8	93.7	89.6	80.9
TDN, percent..... :	42.1	25.5	24.0	20.5	19.5
Net energy, percent :	47.2	29.6	28.6	25.5	19.5

1/ Adapted from table 69, USDA Tech. Bul. 1079, 1954.

The comparative yields of protein and digestible nutrients available for feeding from a standing crop yielding 2 1/2 tons of dry matter

per acre have been estimated in table 9. The saving in digestible protein and TDN, when using alternatives to field curing, point up the opportunities for farmers to increase the efficiency of their feed production methods and reduce the purchased feed bill. To illustrate, when figured on a grain replacement basis, making silage compared to making field-cured hay saved as much TDN and more protein than is contained in 600 pounds of a 2<sup>4</sup> percent grain mixture.

Table 9.- Estimated comparative yields of feed nutrients from alfalfa mixed forage when harvested in different ways, and the grain sparing effect of improved harvesting methods 1/ 2/

Method of harvest	Per acre yield of feed			Increase over average of 1 and 2 3/			Grain mix		
	Total	Digestible protein	Digestible nutrients	Total	Digestible protein	Digestible nutrients	equivalent	4/	Grain
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1. Field-cured hay - rain	571	393	1,795	-	-	-	-	-	-
2. Field-cured hay-no rain	715	505	2,336	-	-	-	-	-	-
3. Barn dried hay - no heat	753	536	2,347	110	87	281	375		
4. Barn dried hay - heat	784	562	2,463	141	113	397	530		
5. Wilted silage	832	568	2,517	189	119	451	600		
6. Dehydrated hay	803	547	2,703	160	98	637	850		

1/ Adapted from tables 68 and 69, USDA Tech. Bul. 1079, 1955.

2/ Assuming a dry matter yield in each case of 2 1/2 tons per acre.

3/ Assuming that at least half the crop would be rained on during harvest.

4/ A 2<sup>4</sup> percent grain mixture containing 75 percent TDN.

As shown in table 10, the silage and artificial drying methods of harvesting were much more effective in preserving the leaves and the green color of the forage than were the various methods of making hay.

Table 10.- Effect of method of harvesting on leaf content and color of alfalfa forage 1/

Method of harvest	Leafiness		Color	
	: After		: After	
	: As cut	: harvesting	: As cut	: harvesting
	: Percent	: Percent	: Percent	: Percent
Field-cured hay (no rain)	: 50	: 40	: 69	: 50
Field-cured hay (rained on)	: 49	: 29	: 74	: 29
Barn-dried hay (heat).....	: 46	: 40	: 69	: 56
Barn-dried hay (no heat)...	: 47	: 42	: 66	: 51
Wilted silage.....	: 48	: 48	: 69	: 56
Dehydrated hay.....	: 47	: 48	: 71	: 52

1/ Adapted from Table 72, USDA Tech. Bul. 1079, 1954.

### Grass Silage High in Feeding Value

Results like these are indicative of why we are giving so much attention to grass silage as a way of harvesting the forage crop. Comparative feeding tests on these same experimental forages, as indicated in table 11, show that when the different forages were fed at about the same level of dry matter intake the silage was at least as palatable and effective in maintaining milk production as the dry forages, and better than the poorer grade field-cured hay that was damaged by rain. The silage made was of moderate moisture content, due to slight wilting of the forage. The forage was ensiled without a preservative and was of good quality.

### Need for Improving Methods of Making Grass Silage

While the silage method appears to be a good practical method of preserving nutrients in harvested forages, the total losses of dry matter under the best of conditions still average 15 to 20 percent. There is room for research to develop methods of ensiling that will preserve feed with smaller losses. It has been our experience that the moisture content of the forage ensiled in upright silos has considerable to do with the extent of dry matter and nutrient losses. This is indicated in table 12. Other results, even where chemicals or molasses preservatives have been used in forage of different moisture content, show that losses are invariably higher in the high moisture silage.

Table 11.- Results of comparative feeding tests using forage harvested in different ways 1/

Items compared	Field-cured hay		Barn-dried hay		Wilted		Dehydrated silage	
	Rained:		No rain		No heat		Heat	silage
	on	:No rain:	No heat:	Heat	Heat	Heat	silage:	hay
Number trials	:	1	:	2	:	3	:	3
Milk production (FCM), av. daily, pounds.....	:	35.2	:	34.0	:	33.7	:	35.7
Ave. 30-day decline in production, percent...	:	13.6	:	6.7	:	8.1	:	8.8
Change in weight, av. daily, pounds.....	:	-.19	:	+.20	:	-.12	:	-.12
Dry matter consumed from: experimental forage, av. daily, pounds.....	:	14.3	:	17.7	:	19.0	:	18.2
Total dry matter con- sumed, av. daily, pounds.....	:	30.2	:	31.4	:	32.7	:	33.1
Dry matter consumed per 100 pounds weight, ex- perimental forage ave. daily, pounds.....	:	1.24	:	1.58	:	1.65	:	1.53
Total dry matter con- sumed per 100 pounds body weight, av. daily pounds.....	:	2.62	:	2.80	:	2.85	:	2.79
								1.46
								31.6
								2.73
								2.71

1/ Adapted from table 74, USDA Tech. Bul. 1079, 1954.

### Bunkers and Trenches for Grass Silage

Considerable research is being directed at storing grassland forage in trench and bunker-type silos. Farmers are taking up this method of making grass silage to an increasing extent. While these types of storage have a number of appealing advantages, there is too little information available on the input-output relationships compared to upright silos. Earlier work in Washington State (Wash. Agr. Expt. Sta. Bul. 348) with earth covered stack silos showed a recovery in good silage of 70 to 80 percent as much as obtained with the upright silo. Dry matter losses in the stacks averaged 31 to 35 percent. For each 100 pounds of dry matter ensiled, an estimated 40 pounds of TDN were recovered for feeding in the stacks, compared with 42 pounds for the upright silos. The forage used in these tests had a moisture content of about 75 percent when ensiled.

Table 12.- Relation of moisture content of forage to dry matter losses of silage stored in tower silos (Beltsville)

Forage	Moisture Content	Depth of silage stored in silo	Total loss of dry matter <sup>1/</sup>
	of silage		
	<u>Percent</u>		
<u>1956 experiment</u>			
Orchard grass	70	25	13.7
" "	78	25	22.1
<u>1957 experiment</u>			
Orchard grass	71	35	7.9
" "	76	35	13.0

1/ Including top spoilage.

On the basis of our limited experience at Beltsville in making grass silage under a variety of conditions, and when so-called preservatives have not been used, we have estimated the minimum losses of dry matter resulting from ensiling forage of different moisture content and stored in different kinds of structures, and where special types of covers have not been used, to be about 25 to 30 percent. This is not much better preservation than for making hay. If these newer type storage structures are to be successful, they should do a better job of preserving dry matter and feed nutrients than field curing. One way of reducing these losses is to provide a better top cover on the surface of the bunker or trench. Plastic covers offer real possibilities for doing this.

#### The Use of Plastic Covers on Bunker Silos

The development of plastic covers will probably materially advance the use of bunkers and trench silos and stacks. The plastic cover prevents water from rain or snow from penetrating the silage mass and permits the exclusion of air from the large surface of bunkers and trench silos and stacks. The usually large loss of 25 to 30 percent or more of the dry matter attendant with poor packing or heavy rainfall in the uncovered forage can be reduced to 15 percent or less. This remaining loss is primarily due to fermentation and seepage with little or no surface spoilage.

Recent work at Beltsville with plastic covers for bunker silos, as shown in table 13, indicates the effectiveness in reducing surface losses of silage. These data show that with an effective plastic cover the total losses in bunkers can be reduced to below that obtained in tower silos.

It should be pointed out that a successful plastic cover must be heavier and stout enough to resist puncturing and tearing, otherwise it will not do the job. Air must not get under the cover nor carbon oxide allowed to escape. Covering the plastic with a few inches of sawdust adds materially to its effectiveness as a cover.

More research is needed to determine and to improve the efficiency of the tower, bunker, trench and stack type storage structures and to develop methods of storages with minimum amounts of loss of feed nutrients.

Table 13.- Comparative losses in forage ensiled in plastic covered bunker and tower silos 1/ 2/

Storage structure	Percent of dry matter stored that was lost				
	Surface spoilage	Seepage	Invisible	Total	
1956 experiment					
Tower silo	0	8.2	13.9	22.1	
Bunker	0.4	3.7	10.7	14.8	
1957 experiment					
Tower silo	0	6.6	6.4	13.0	
Bunker	2.5	1.8	5.4	9.7	

1/ High moisture grass-clover forage ensiled with sodium-meta-bisulfite added as a preservative.

2/ Unpublished data - Beltsville.

#### Factors Affecting Palatability of Grass Silage

If we are to place more emphasis on forage in the ration and at the same time place more dependence on grass silage instead of hay, the silage must be of good quality and palatable so that cows will eat it

in large amounts. Our knowledge of what constitutes a highly palatable silage--one that cows like and will eat a lot of--is limited. The strong odors of some silages do not seem to affect the cows as much as they do people. Our experience tells us that cows and heifers will consume more dry matter from silage with a relatively low moisture content than from silage of high moisture content, ensiled with or without a preservative. Table 14 summarizes some of our information on this point. This, it seems to me, is a compelling reason, among several others, for putting up silage with a moderate moisture content, 63 to 70 percent.

Considerable work has been done at Beltsville on raising calves and heifers on rations in which all or a large part of the roughage has been provided as grass silage. Irrespective of the moisture content of the silage, young dairy stock do not seem to be able or willing to consume enough forage as grass silage to make growth increases comparable to similar animals on good hay or part hay - part silage forage rations. It is evident that young growing heifers need to have the silage supplemented with a small amount of good hay or with increased amounts of grain to achieve normal growth.

#### Adjust Herd Size to Forage Capacity of Farm

When a farmer has developed on his farm an adequate supply of high quality forage as pasture, hay and grass silage that is available to his herd with a minimum of loss of feed nutrients, he has the basis for an economical dairy ration. Such feed, when grown from soil that is properly managed and fertilized, provides most all the nutrients needed for maintenance and liberal production. He should then adjust the size of his herd to fit the forage supply, with each animal provided all it will eat each day of the year. For higher milk production grain should be added to the ration to get extra milk insofar as it is economical and does not materially reduce feed consumption.

Table 14.- Relation between the moisture content of silage and the amount of silage dry matter consumed by dairy cows 1/

Crop harvested	Moisture content of silage	Dry matter eaten per 100 lbs. of live weight per day
	Percent	Pounds
Orchard grass:		
First cutting (boot stage):		
Fresh green.....	79.7	1.36
Wilted.....	66.9	2.00
Second cutting (early hay stage):		
Fresh green.....	71.8	2.08
Fresh green + 5% dry grain.....	69.7	2.21
Wilted.....	59.5	2.11
Alfalfa:		
First cutting (1/10 to 1/4 bloom):		
Fresh green.....	77.9	1.23
Wilted.....	72.7	1.94
Wilted.....	65.6	2.34
Half-dry 2/.....	45.7	2.52
Soybeans:		
First pods forming (dry season):		
Fresh green.....	74.1	1.52
Fresh green + 10% dry grain.....	69.9	2.19
Wilted.....	58.1	1.85

1/ From Beltsville experiments in 1950-52, reported in BDI-Inf. 149, 1952.

2/ In gas-tight silo; no mold.

### Summary

I have tried to show you how grass and the cow go together to furnish an efficient farming enterprise that results in economical production of milk. I have pointed out some of the necessary things to do to insure the animal an adequate amount of good quality grass. It is equally important that the cow used also be of good quality, possessing the inherent ability to efficiently convert grass into milk and to produce large amounts of milk. Time does not permit a discussion of this important problem.

I began this discussion by quoting a fine tribute to grass. I conclude by the following tribute to the dairy cow:

This noble beast, the real princess of the American countryside, serves her master well and fills the consumer's cup to overflowing with nature's most refreshing and healthful food. Whether she is clothed in the golden cream color of the Guernsey, the fawn color of the Jersey, the brown of the Swiss, the black and white of the Holstein-Friesian, or the red and white of the Ayrshire and Milking Shorthorn, she has earned her keep, and more, by transforming the raw materials - the grasses, legumes and grains, grown from the farmers' soil - into a readily marketable product important to every man, woman and child.



